

Event-related (de)synchronization during comprehension of a foreign language

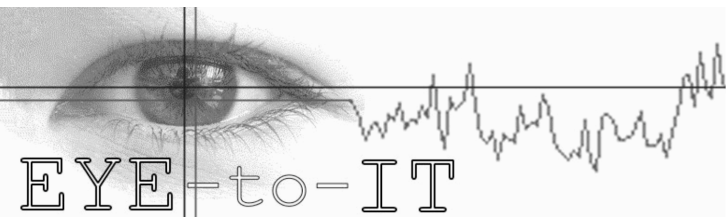
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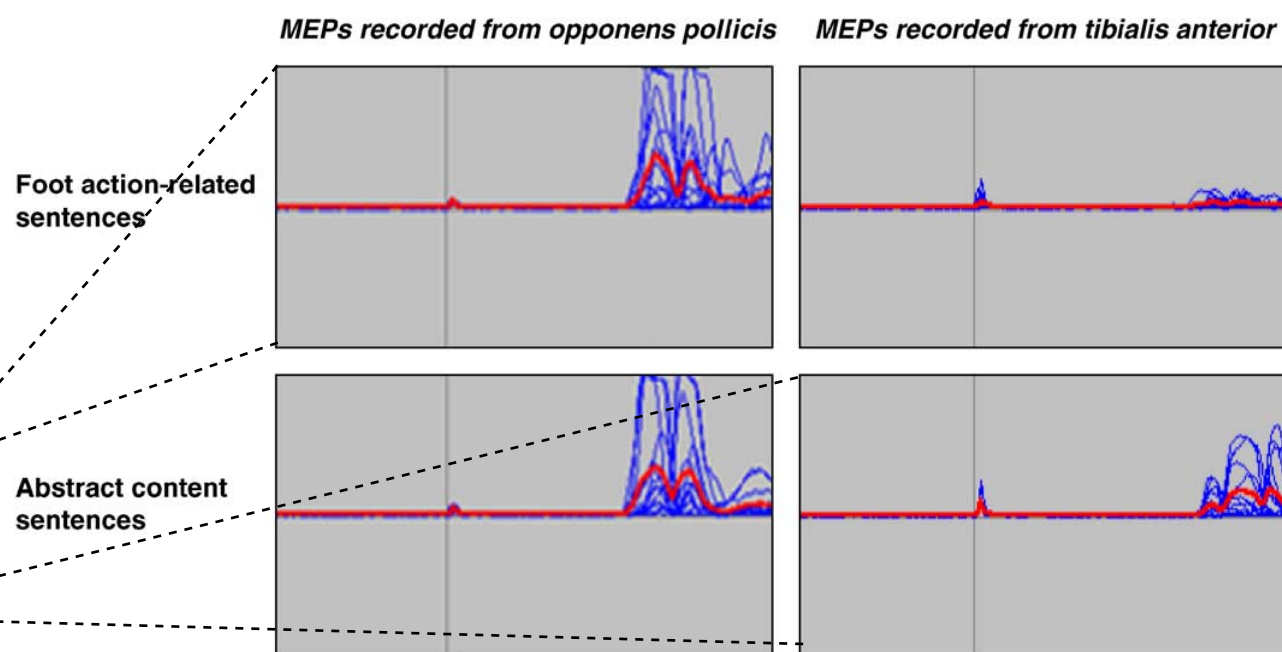
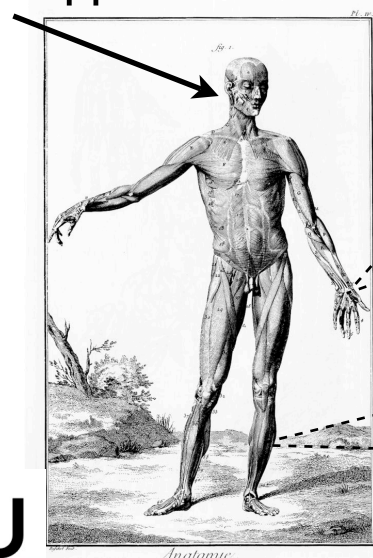


Semantic processing

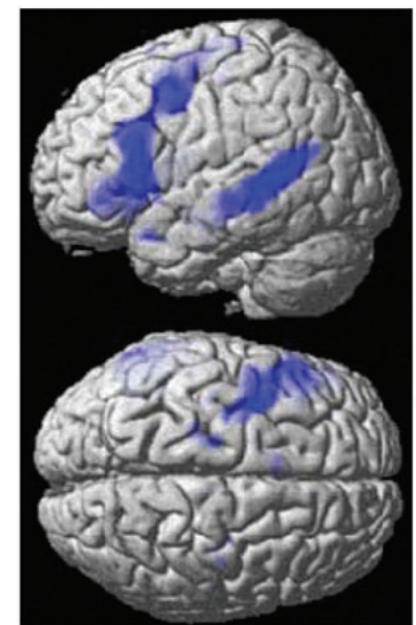
- Sensorimotor cortex is involved in language comprehension and language translation
- Motor system is regulated by processing of action related phrases

“he marched on the place”

“he liked the apple”



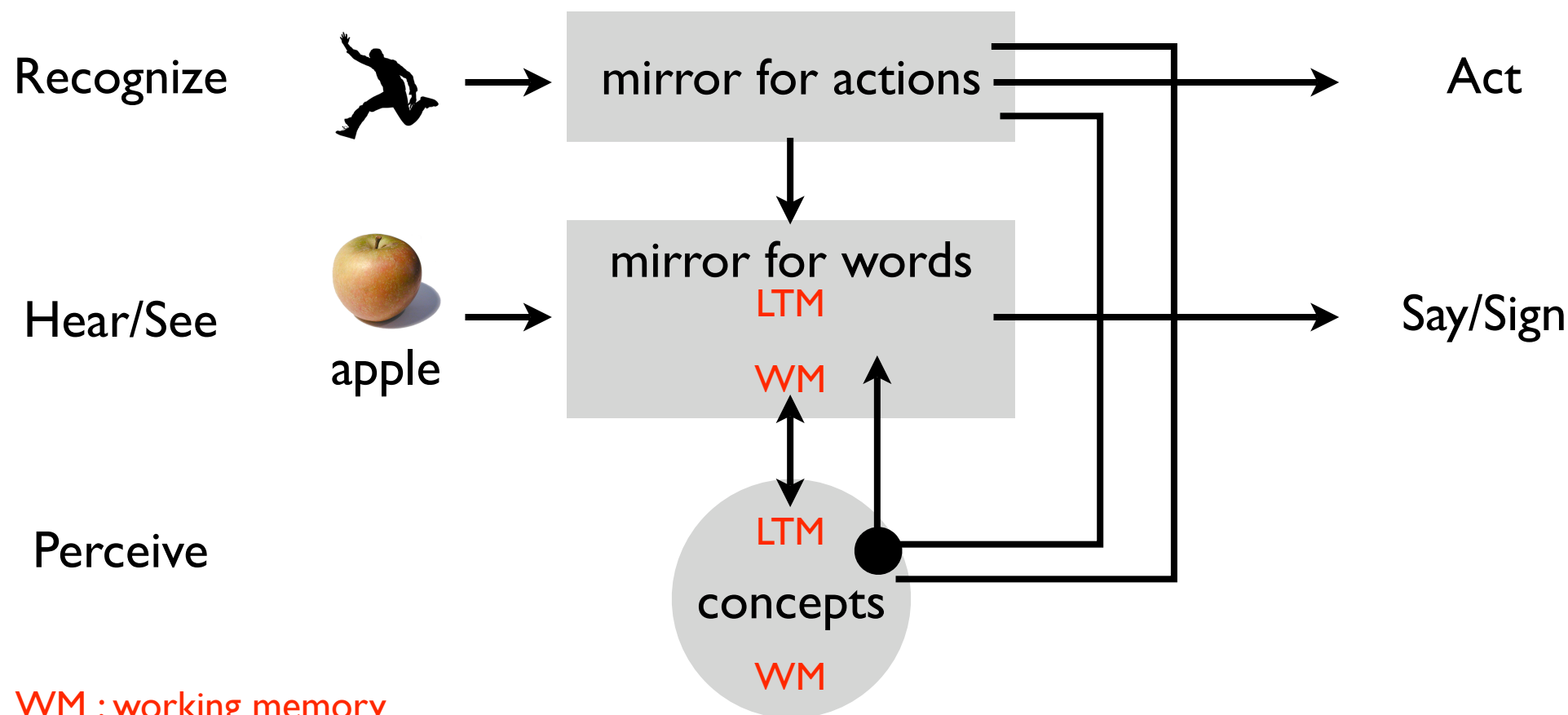
“Mary grasped the idea”



V. Boulenger et al. Cerebral Cortex
doi:10.1093/cercor/bhn217

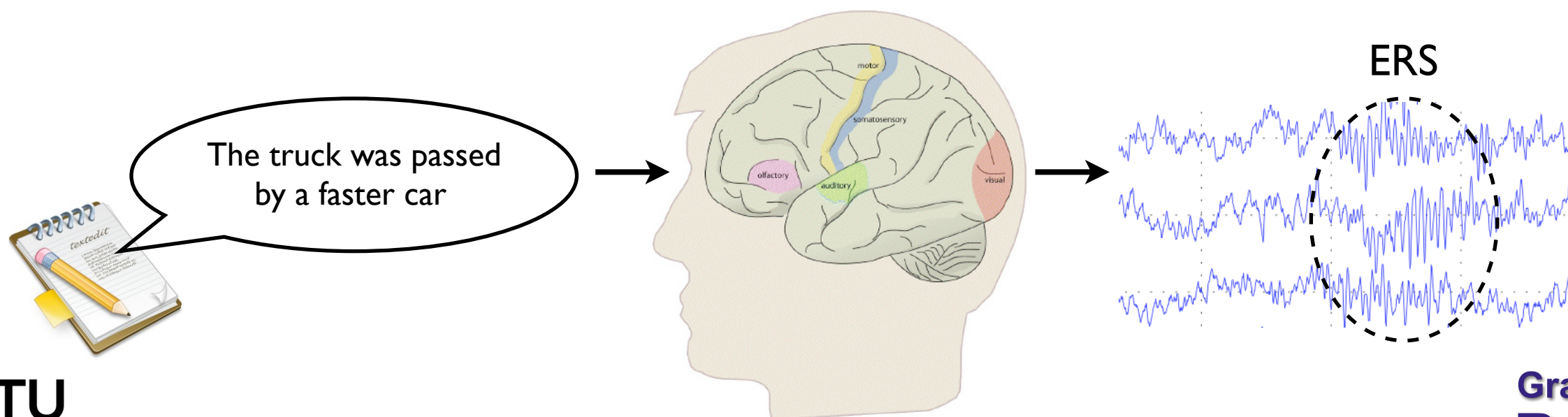
Embodiment of actions

- Sensorimotor functions help to structure thoughts about actions by simulation of this processes



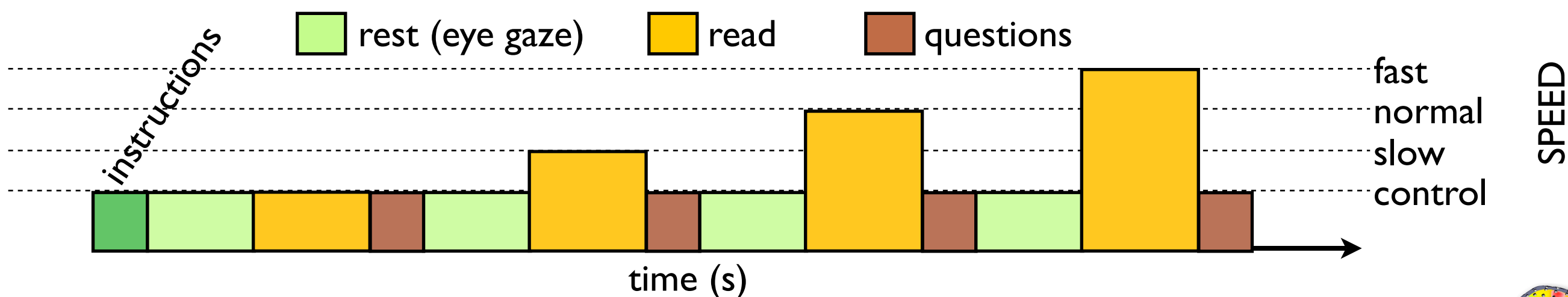
Aim

- Investigate the dynamics of EEG oscillations during comprehension of a foreign language
- Search for possible event-related (de)synchronization of the sensorimotor rhythms related to speed simulation

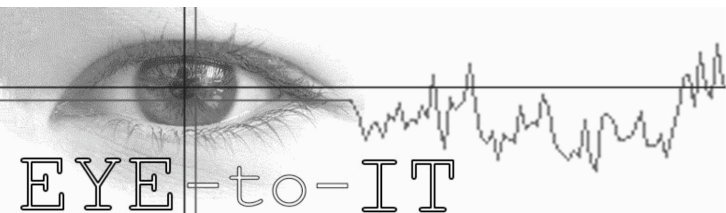


Experiment

- Reading and comprehension task in L2 (foreign language)
- Texts contained actions described in 3 different speeds
- neutral, slow and fast, plus a control condition (no actions)



* order was randomized, except for control condition



Text example

slow

It was a cold morning but the sun was shining. Tom was **waiting** for the next bus, as a man in a red hat **strolled** passed with his dog, and a **weary** cat went **slouching**. Tom **drifted** off of the pavement and onto de bus. He looked out of the window as the bus **trudged** off and overtook the man in the hat **sitting** with his dog in the nearby park. Tom noticed a **milk car rambling** across the road, and a **walker** following lazily behind. The ticket inspector was **crawling** up and down the bus, looking annoyed with his job. Tom realized the next stop was his, and **edged** towards the front of the bus very **slowly**. As he **slumped** off the bus, he accepted that today was going to be a fairly **quiet** day.

neutral

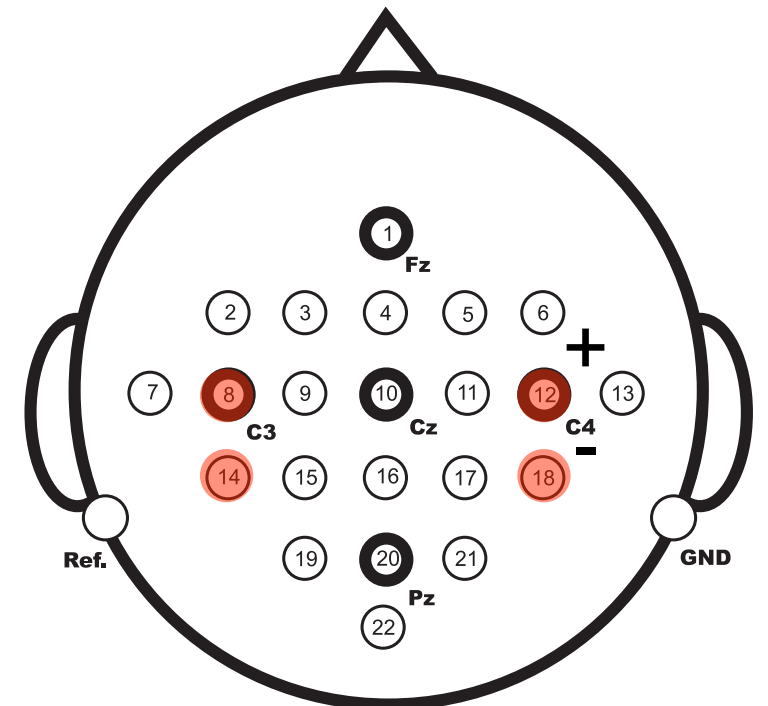
It was a cold morning but the sun was shining. Tom was **walking** for the next bus, as a man in a red hat **traveled** passed with his dog, and a **brownish** cat went **passing** by. Tom **stepped** off of the pavement and onto de bus. He looked out of the window as the bus **drove** off and overtook the man in the hat **wandering** with his dog in the nearby park. Tom noticed a **hire van moving** across the road, and a **jogger** following casually behind. The ticket inspector was **moving** up and down the bus, looking annoyed with his job. Tom realized the next stop was his, and **headed** towards the front of the bus very **easily**. As he **got** off the bus, he accepted that today was going to be a fairly **average** day.

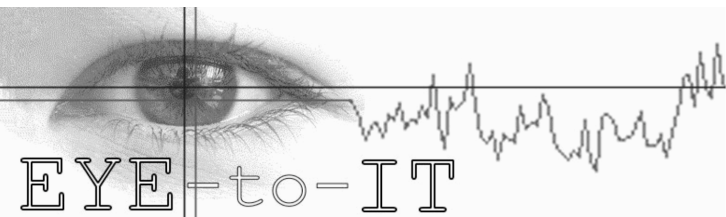
fast

It was a cold morning but the sun was shining. Tom was **running** for the next bus, as a man in a red hat **raced** passed with his dog, and a **lively** cat went **dashing**. Tom **jumped** off of the pavement and onto de bus. He looked out of the window as the bus **zoomed** off and overtook the man in the hat **sprinting** with his dog in the nearby park. Tom noticed a **sports car speeding** across the road, and a **cyclist** following **rapidly** behind. The ticket inspector was **rushing** up and down the bus, looking annoyed with his job. Tom realized the next stop was his, and **dashed** towards the front of the bus very **promptly**. As he **leaped** off the bus, he accepted that today was going to be a fairly **busy** day.

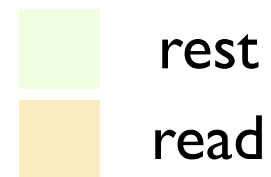
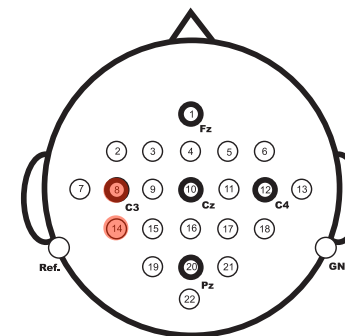
Methods

- Participants: 9 professional English-Norwegian translators
- Signals: 2 EEG bipolar channels over C3 and C4 electrode positions
- Analysis:
 - Event-related (de)synchronization
theta, mu and beta rhythms
 - ANOVA for repeated measurements (SPEED x CHANNEL)





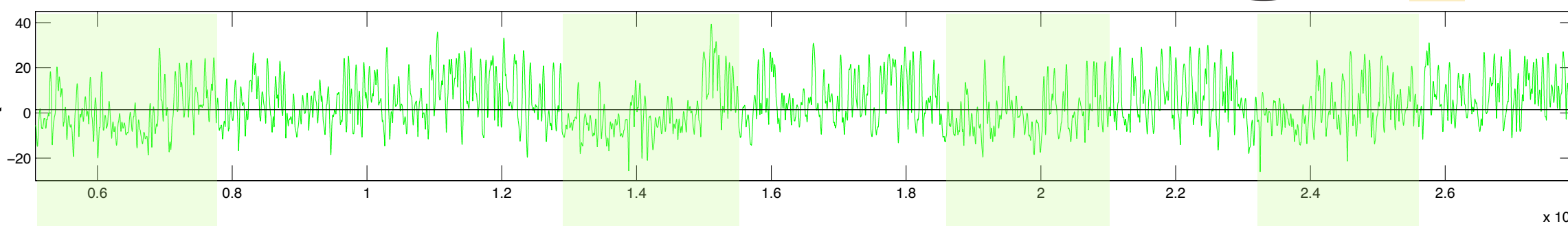
Methods



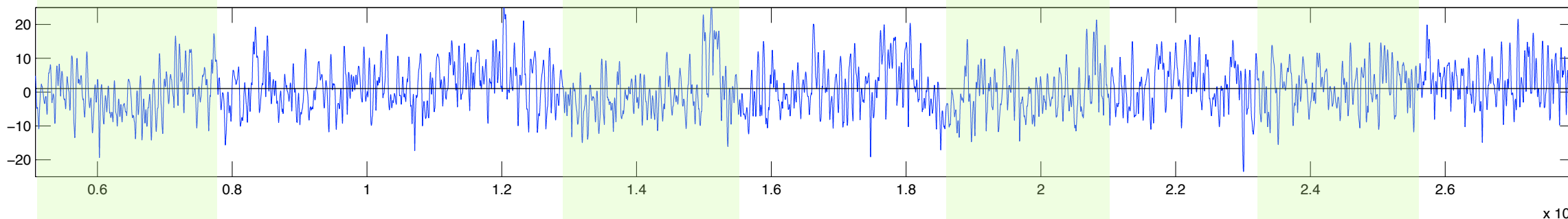
ERDS

%

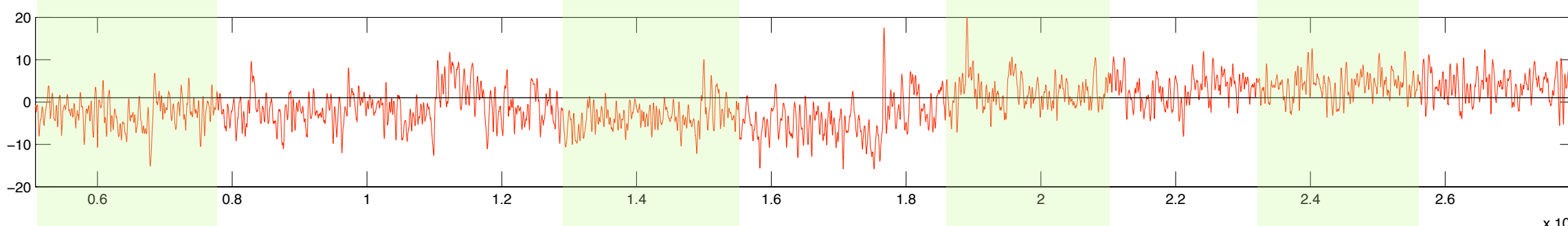
theta



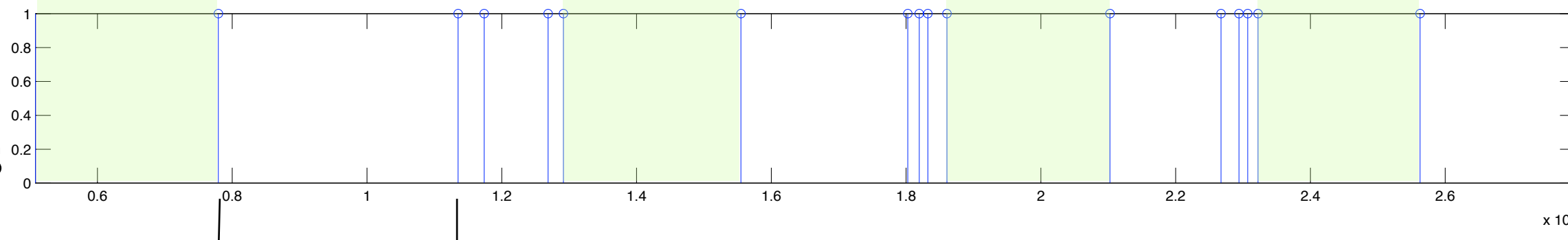
mu



beta

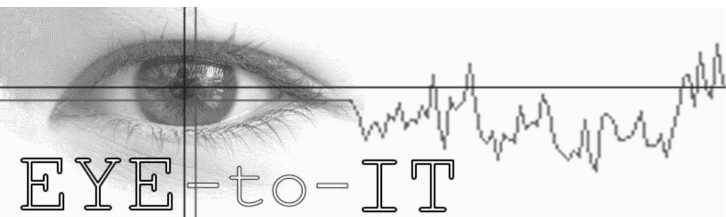


press

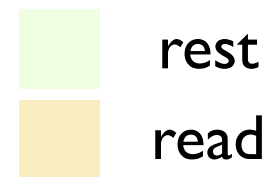
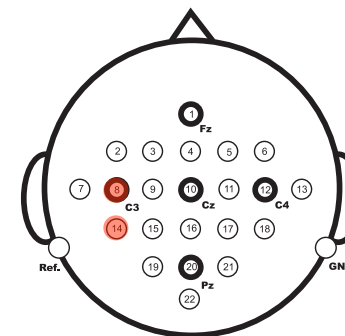


control

samples (n)



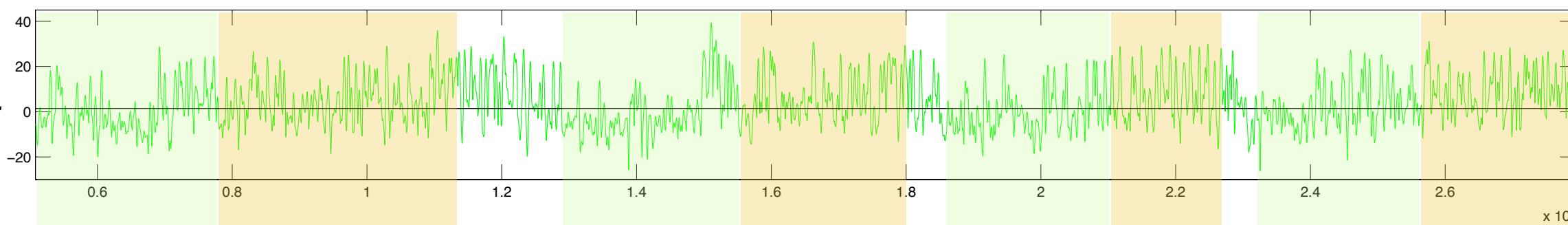
Methods



ERDS

%

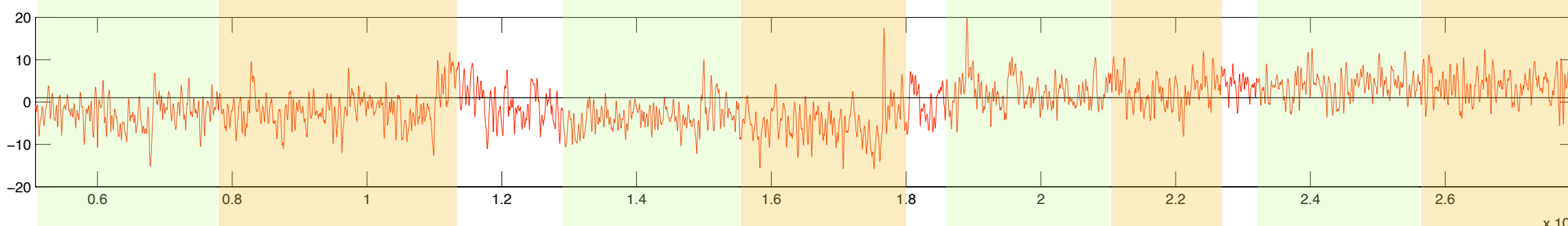
theta



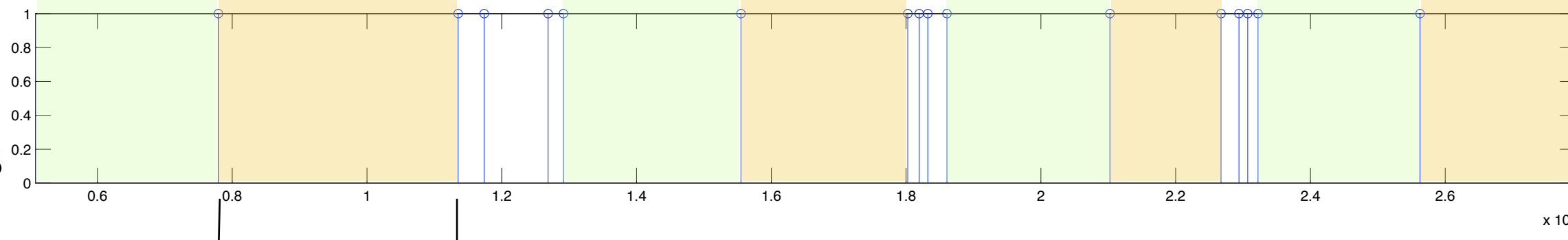
mu



beta



press

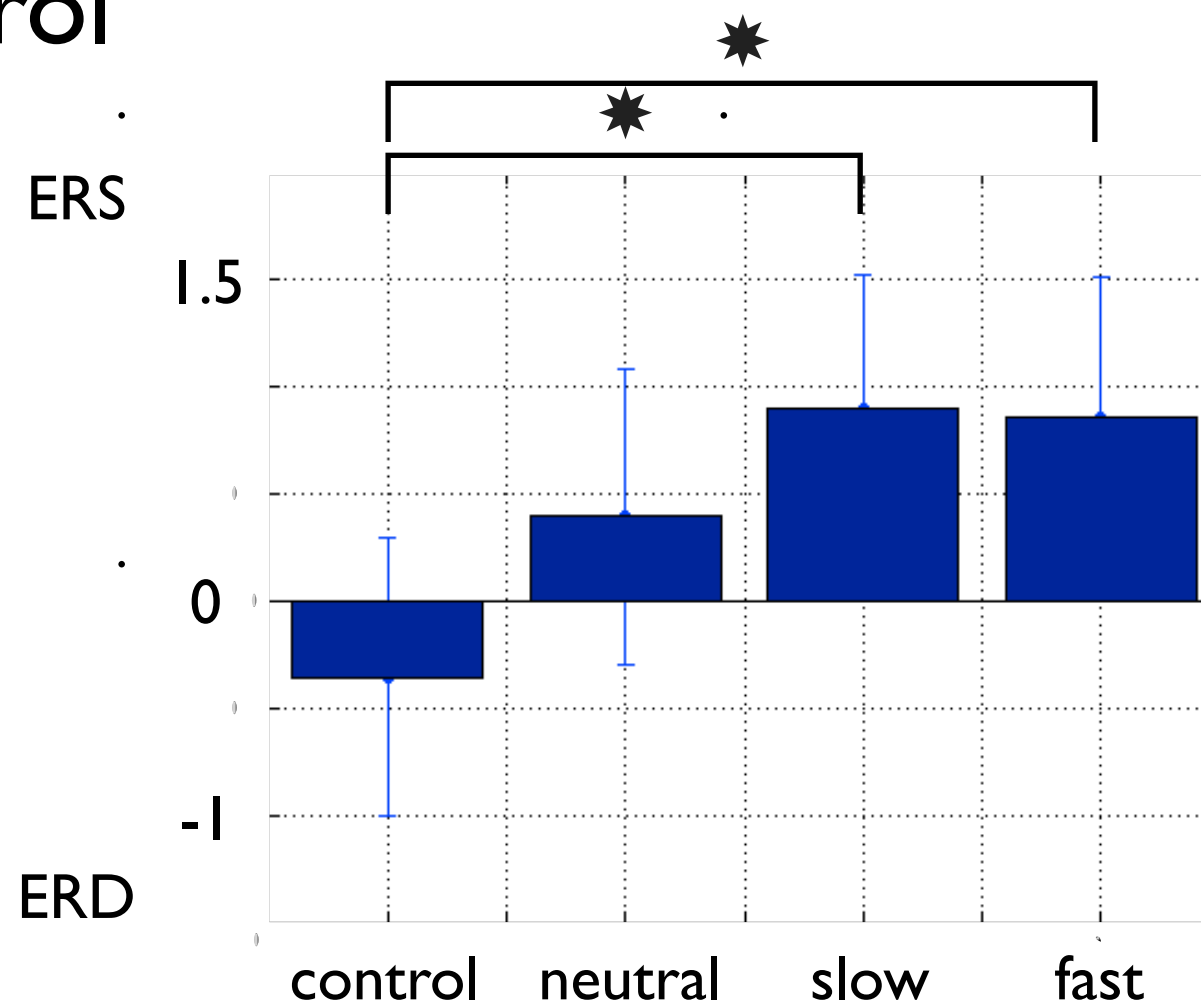


control

samples (n)

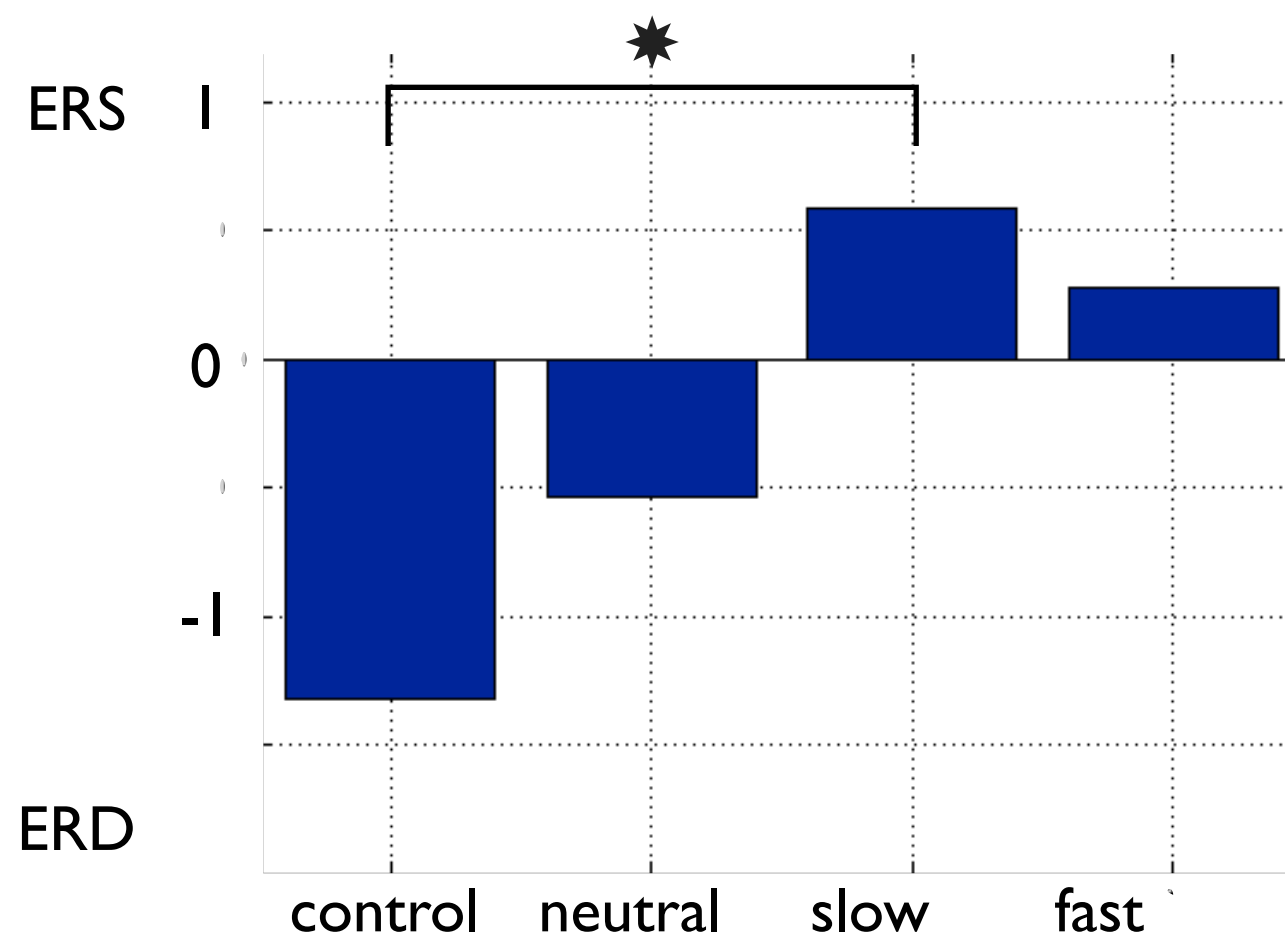
Results

- ERS (increase of power) in the mu band between slow and fast speeds and the control



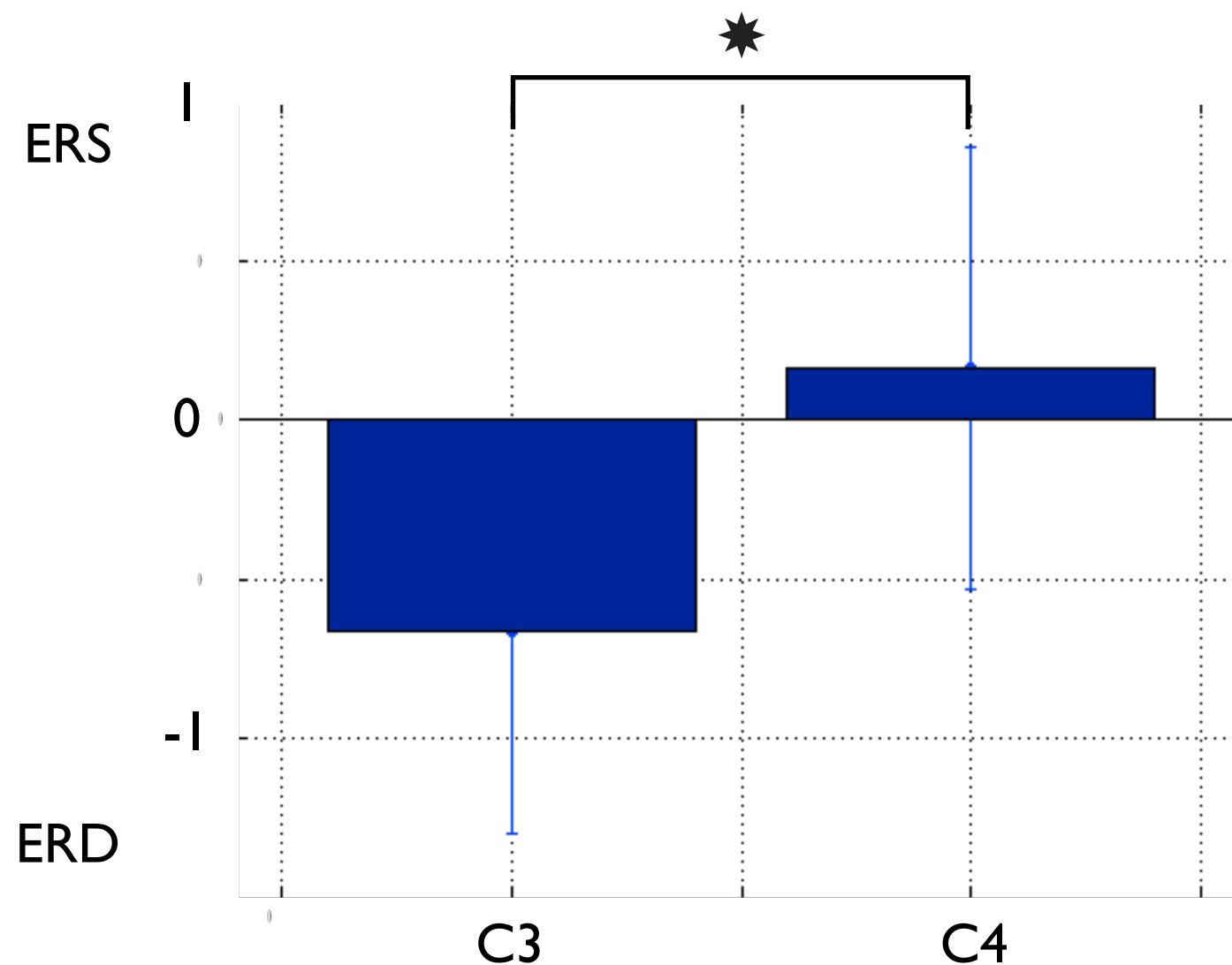
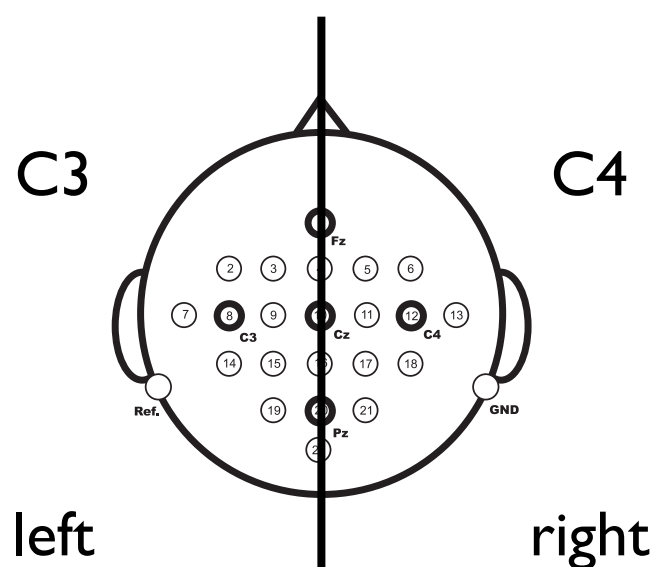
Results

- ERS in the beta band between the slow speed and the control condition



Results

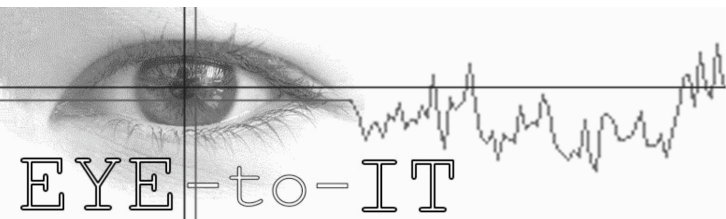
- Marginal significant ($p = 0.07$) differences between channels



Discussion

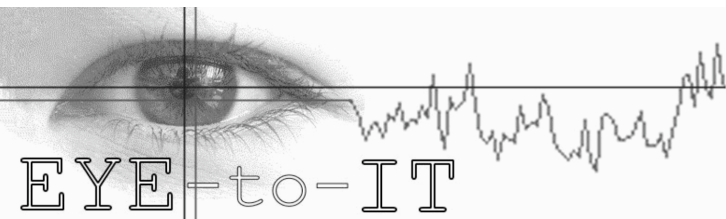
- Limitations due to the number of channels and the type of text are present
- Speed simulation was proved to occur with a behavioral study (Eye tracking data analysis from this experiment)
- Duration (due to speed) was not significant

Fougner Rydning & Janyan.
2008. Forum 6:1. 59-74.



Discussion

- Mu and beta band are related to the neural networks from the motor cortex and thus affected by the embodiment of actions
- Different speeds did not elicited different responses on the EEG

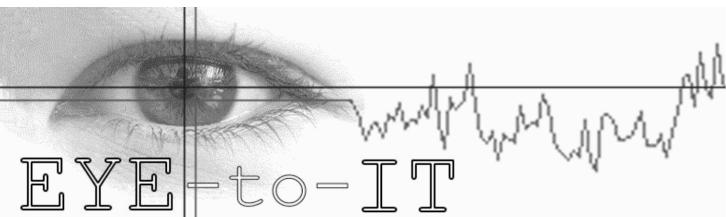


Discussion

- Motor action effectively affected the mu band
- Differences in channels, i.e. hemispheres, are most likely due to language processing

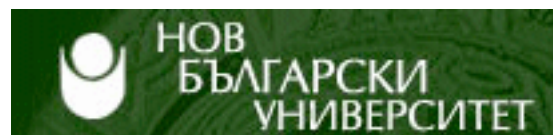
Conclusions

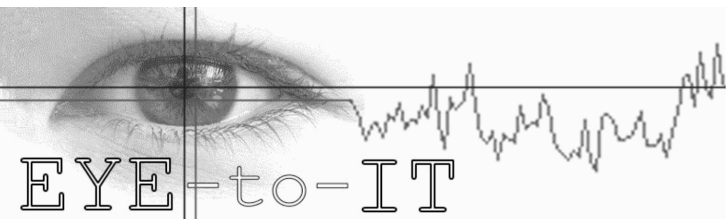
- The EEG power (mu band) is affected by inclusion of text describing motor actions
- No differences between speeds were found
- Comparisons with a group of bilinguals with less developed translation skills are interesting



Acknowledgements

- This work was supported by the 'Eye to IT' research grant (FP6-517590)





Thank you